The Biology Unit is based on the *Nelson Science 9* textbook, Chapters 5-7. Answer all questions neatly in sentence form. These answers will form the bulk of your notes.

CHAPTER 5

Microscopes And The Development of Cell Theory (pp. 140-141)

1. a) Who was the first scientist to view cells under a microscope, and in what year?
   b) What was it that he actually saw and called cells?
2. Who was the first scientist to observe living cells, and when?
   Copy/add this information in your notes (answers) as well: *He is known as the father of microscopy because of his work on lenses to increase the magnification of microscopes.*
3. a) Who was the first scientist to observe something inside cells, and when?
   b) What organelle (internal component of a cell) did he observe?
4. Copy this information : *The simplest type of microscope is the "light microcope"; it comes in 2 types – simple light microscope (single lens) and compound light microscope (2 or more lenses).*
   a) What is an advantage of a light microscope?
   b) What is a disadvantage/limitation of a light microscope?
   c) What is the maximum magnification of a light microscope?
5. a) What is an advantage of a transmission electron microscope?
   b) What is a disadvantage/limitation of a transmission electron microscope?
   c) What is the maximum magnification of a transmission electron microscope?
6. a) What is an advantage of the scanning electron microscope?
   b) What is a disadvantage/limitation of a scanning electron microscope?
   c) What is the maximum magnification of a scanning electron microscope?
7. Referring to Table 1, list the following in order from smallest to largest: organ, bacterium, plant cell, animal cell, molecule, organism, virus

Microscopes And The Development of Cell Theory (pp. 140-141)

1. a) **Robert Hooke** was the first scientist to view cells under a microscope, in 1665.
   b) Hooke examined a piece of cork (inner bark from oak trees), and what he observed were the rigid cell walls that had surrounded the once-living plant cells.
2. **Anton van Leeuwenhoek** was the first scientist to observe living cells, about 10 years after Hooke (late 1600s). *He is known as the father of microscopy because of his work on lenses to increase the magnification of microscopes.*
3. a) **Robert Brown** was the first scientist to observe something inside cells, in 1820.
   b) He observed the nucleus of a cell (the largest internal component).
4. *The simplest type of microscope is the "light microcope"; it comes in 2 types – simple light microscope (single lens) and compound light microscope (2 or more lenses).*
   a) The advantage of a light microscope is live cells can be viewed.
   b) A disadvantage/limitation of a light microscope is its relatively low magnification.
   c) The maximum magnification of a light microscope is 2000x.

5. a) An advantage of a transmission electron microscope is the high magnification.
   b) A disadvantage/limitation of a transmission electron microscope is that cells must be destroyed to view them, so living cells cannot be viewed.
   c) The maximum magnification of a transmission electron microscope is 2,000,000x.
6. a) An advantage of the scanning electron microscope is that it shows a 3D (3-dimensional) image.
   b) A disadvantage/limitation of a scanning electron microscope is that it does not have the resolution or as high magnification of the transmission electron microscope. (Cannot view living cells, similar to transmission electron microscope.)
   c) The maximum magnification of a scanning electron microscope is about 500,000x.
7. From smallest to largest:
   molecule, virus, bacterium, animal cell, plant cell, organ, organism

Defining "Life": The Development of Cell Theory (pp. 144-147)

8. Powerpoint: "MicroscopesAndCells.ppt"
9. Write the name and explanation for Aristotle's theory of how living things can get started.
10. What scientist first questioned Aristotle's theory (s.g.) in 1668, by showing that simple organisms only come from simple organisms, and cannot develop from nonliving material? (Hint: summarizing sentence is at top of p. 145.)
11. About a hundred years after Redi's work, John Needham partially agreed with Redi (living organisms cannot come from nonliving material), but he partially disagreed. What did he demonstrate/conclude from his experiments?
12. About 25 years later (after Needham's work), Lazzaro Spallanzini questioned Needham's experiment – what did he conclude? What 2 things did he do differently than Needham?
13. In the later 1800's, who "put the nail in the coffin" of any suggestion of life somehow developing from nonliving material?
14. List the 3 premises of cell theory.
15. Write a definition of "life" or "living" or "alive". Use your own words.

Defining "Life": The Development of Cell Theory (pp. 144-147)

8. Powerpoint: "MicroscopesAndCells.ppt"
9. **Spontaneous generation** is the name of Aristotle's theory of how living things can get started – living things can come from non-living things without any external causes.
10. Francesco Redi questioned Aristotle's theory in 1668, by showing that simple organisms only come from simple organisms, and cannot develop from nonliving material.
11. About a hundred years after Redi's work, John Needham concluded that microbes (tiny one-celled organisms) can indeed come from non-living material, although larger organisms cannot.

12. About 25 years after Needham's work, Lazzaro Spallanzini disagreed with Needham, and showed that if the flask was sealed tightly, and the broth heated longer, even tiny microbes did not appear from the nonliving material.
13. In the later 1800s, Louis Pasteur finally demolished the theory of spontaneous generation, by using specially designed flasks that eliminated any possibility of microbes entering the broth from the surrounding air.
14. The 3 premises of cell theory are:
    - All living things are made of one or more cells.
    - The cell is the functional unit of life (i.e. life is carried out by cells)
    - All cells come from preexisting cells.
15. To be alive means to be made of functioning cells.

Cell Components: Organelles and Their Function (pp. 142-143)

16. What are the 3 main parts of a cell? (Hint: cm, n, and c)
17. Where is the genetic information found in the cell?
18. Looking at the diagram in Figure 1, list each organelle and write out its function.
19. Looking at the diagram in Figure 2, you should notice 3 organelles that look different and were not found in the animal cell. List these 3 organelles and write out their functions.
20. The diagram of the animal cell in Figure 1 should have show several small, round vacuoles. Bearing this in mind and examining the 2 diagrams, list 4 differences between an animal cell and a plant cell.
21. When looking under a microscope, what do you suppose is the most recognizable difference in an animal and a plant cell? (Hint: think about the first cells observed by Hooke)
22. How does the structure of a plant cell differ from that of an animal cell?
23. What can a plant cell do that no animal cell can? What plant-cell structure enables it to carry out this function?
24. Some cells need to be able to move around. How do they do it?
25. Watch VHS video, "*Simply Cells*" (by *Teachers Video Company*)
26. Powerpoint: "Cells.ppt"
27. Go to website http://www.execulink.com/~ekimmel/drag_gr11/organell.htm and try the exercise on definitions of the functions of cell organelles.

Cell Components: Organelles and Their Function (pp. 142-143)

16. The 3 main parts of a cell are the cell membrane, nucleus, and cytoplasm.
17. The genetic information is contained in the chromosomes, which are inside the nucleus.
18. **cell membrane** - semi-permeable layer that encloses the cell and controls movement of materials into and out of the cell.
    centriole pair - pair of barrel-shaped structures near the nucleus that participate in cell division (animal cells only).
    chromosome - individual or paired threadlike structure in the nucleus that contains the genes (made up of DNA)
    chromatin - fibrous strands of material that contain the chromosomes and connecting material.

cytoplasm - thick fluid/gel throughout the cell that contains all the organelles
endoplasmic reticulum - series of canals or tubes, attached to or near the nucleus, that carry materials
Golgi apparatus - cluster of membranes that package, store, and transport proteins
lysosome - fluid-filled sac that contains digestive enzymes that process waste by breaking down large molecules (animal cells only).
mitochondrion - powerhouse of the cell that generates energy.
nucleus - control center, directing all cell activity, and containing the chromosomes.
nucleolus - one or several spherical sacs within the nucleus that build ribosomes.
ribosome - numerous tiny spherical organelles that make proteins, usually attached to the e. r., but may also travel freely throughout the cytoplasm.
vacuole - animal - several oval or spherical fluid-filled sacs (usually fairly clear/transparent) containing nutrients
vacuole - plant - one (maybe 2 or 3) large fluid-filled sacs (usually fairly clear/transparent) containing nutrients and the digestive enzymes to break down waste.

19. Organelles only in plant cells:
cell wall - thick outer layer of cellulose that give plant cells their rigid structure.
chloroplast - contains green chlorophyll used in photosynthesis.
large vacuole - large fluid-filled space containing water, sugar, minerals, proteins, and digestive enzymes to handle waste.
20. 5 differences between an animal cell and a plant cell:
    1. Plant cells have a cell wall giving rigid shape.
    2. Plant cells have a large vacuole.
    3. Plant cells have chloroplasts.
    4. Animal cells have lysosomes.
    5. Animal cells have centriole pairs.
21. When looking under a microscope, the cell wall in plants is the most recognizable difference in an animal and a plant cell.
22. Plant cells have a rigid structure, whereas animal cells have various and flexible shapes.
23. Plant cells can carry out photosynthesis, because they have chloroplasts.
24. Cells that need mobility have a flagellum (or several flagella; a whiplike tail), while others have many tiny hairs called cilia.

Cell Division and the Cell Cycle (pp. 148-49; 168-169; 150-157)

28. Powerpoint: "CellDivision&CellCycle.ppt"
29. Why is cell division important – what are the 3 functions of cell division?
30. What are some kinds of cells of our bodies that replace dead ones (used up) fairly often?
31. What are some kinds of cells of our bodies that seldom or never get replaced after we're fully grown?
32. Do you think you have any cells in your body now that you had at the age of 6? Explain your answer.
33. It can be said, "Cells are like people – they have a life span and a circle of life." Explain this statement.
34. What are the 2 major phases or parts of the life cycle or life span of a cell, and what percentage does each one make up for a typical cell?
35. For most of its life, a cell carries out its purpose or function – liver cells do liver functions, brain cells do brain functions, nerve cells do nerve functions, etc. What is the name of this phase of a cell's life cycle?
36. What is the name of the 4-phase process of a parent cell splitting to become 2 identical daughter cells?
37. For each of the 4 phases of mitosis (PMAT), name the phase, write a once sentence description, and draw a diagram of a cell in that phase.
38. Why does the genetic material need to be duplicated during the final portion of interphase in the cell cycle?
39. At the end of mitosis, a cell splits or separates into 2 cells – what is the name for this separation process? How is it different in animal cells than in plant cells?
40. After mitosis, how do the daughter cells compare to the parent cell?
41. A somatic human cell has 46 chromosomes. After the cell has undergone mitosis, how many chromosomes would you expect to find in each cell?
42. When a new cell begins, what is the first thing it does in this first portion of its interphase?
43. On p. 152 of *Nelson Science 9* text, there are a couple of misunderstandings that could result. First, the red subtitle, "The Phases of Mitosis" should really read, "The Phases of Cell Division". The first phase or step listed is "1. Interphase", which is indeed the first stage of cell division. The 4 phases of mitosis are next (2, 3, 4, 5). The second misunderstanding is the last step should be "6. Cytokinesis". (Interphase is the beginning of each of the 2 new cells, not really part of the division of the original/parent cell.) To try to clarify the stages or phases of the life cycle of a cell in more detail:
    a) Name the 2 phases or portions of a full cell cycle.
    b) Name the 6 phases or steps of cell division.
    c) Name the 4 phases of mitosis.
44. Watch VHS video, "*Mitosis*" (from the "Video Quiz" series by *Teacher Video Company*)
45. Check out the "Cells Alive" website at http://www.cellsalive.com/:
    a) In the upper-left area of Contents, click on "Cell Biology", and then select "*How Big is a . . .*" and notice the differences in sizes of the various living organisms.
    b) Click back on "Cell Biology" in upper-left of Contents, and then select "*Mitosis*" – examine the animation by pressing play, rewind, step forward, step backward.
46. Go to website http://www.biology.arizona.edu/cell_bio/activities/cell_cycle/cell_cycle.html and do the exercise on cells of an onion root tip. Take the time to read the explanations, and patiently try categorizing the 36 different cells. You will find some of them hard to distinguish; don't worry, the program will help you.

Cell Division and the Cell Cycle (pp. 148-49; 168-169; 150-157)

28. Powerpoint: "CellDivision&CellCycle.ppt"
29. The 3 main/important functions of cell division are:
    1. healing (tissue repair by replacing with new cells)
    2. growth (adding more cells)
    3. reproduction of organisms (primarily one-celled organisms)
30. Some kinds of cells of our bodies that get replaced fairly often are: blood, skin, hair, nails
31. Some kinds of cells of our bodies that seldom or never get replaced after we're fully grown are: brain, heart, kidney, eye, nerve
32. Some of the cells in our bodies are the same ones we had at age 6. The human brain is typically fully grown by age 4, so all our brain cells are the same ones we had at age 6. The human heart is fully grown around age 18, so most of those cells are probably the same ones we had at age 6.

33. "Cells are like people – they have a life span and a circle of life." All cells have a beginning and an end. A new cell begins after mitosis, then it grows, functions for most of its life, and then divides. Cells that no longer divide continue functioning until they die.
34. The 2 major phases or parts of the life cycle or life span of a cell are interphase (~90%) and cell division (~10%). (Note: This applies to cells that are still in growth period. Tissue/organs that are fully grown no longer go through division, so would be 100% interphase until they die.)
35. The phase of a cell's life cycle when it is carrying out its regular functions is called *interphase*.
36. The 4-phase process of a parent cell splitting to become 2 identical daughter cells is called mitosis.
37. mitosis = PMAT
    prophase - the connecting fibres in the chromatin dissolve, and the already-duplicated chromosomes thicken and become visible.
    metaphase - the nucleus dissolves and the double-stranded chromosomes line up in the middle of the cell.
    anaphase - each duplicated chromosome splits, and the two halves move to opposite poles of the cell.
    telophase - the chromosomes reach the opposite poles of the cell and a nuclear membrane begins to form around each set.
38. The genetic material need to be duplicated during the final portion of interphase in the cell cycle so that during mitosis, each new daughter gets a complete set of chromosomes.
39. Cytokinesis is the name for the separation process of a cell splitting into 2 cells during telophase. In animal cells, the cell membrane gradually pinches off. In plant cells, a new layer/membrane grows down the middle and builds a new cell wall in the middle as it breaks into 2 cells.
40. After mitosis, the daughter cells are identical to the parent cell.
41. After a somatic human cell with 46 chromosomes has undergone mitosis, there would be 46 chromosomes in each of the daughter cells.
42. When a new cell begins, it is in the first part of interphase, and the first thing it does is grow to full size.
43. a) Name the 2 phases full cell cycle:
        interphase, cell division
    b) Name the 6 phases or steps of cell division:
        ending interphase, P, M, A, T, beginning interphase
    c) Name the 4 phases of mitosis:
        prophase, metaphase, anaphase telophase

Asexual Reproduction (pp. 159-161)

47. Compare the offspring of asexual reproduction with that of sexual reproduction.
48. For each of the 5 types of asexual reproduction, write the name, a one-sentence description, and give an example of an organism that reproduces that way.
49. Why can't the term "zygote" be used for any new cell that begins its life and keeps dividing?
50. What advantages does an organism have when it reproduces asexually? What disadvantages does it have?
51. What advantages does an organism have when it reproduces sexually? What disadvantages does it have?
52. Classify each of the following as one of the 5 types of asexual reproduction:
    a) A potato is cut into pieces, and each piece grows a new potato plant.
    b) After a potato seed piece is planted, the sprouts grow and produce new plants.
    c) A dandelion plant sends out an underground root or "runner" and other dandelions "spring up".
    d) A paramecium (one-celled organism) splits to give two new organisms.
    e) Squash, pumpkin, cucumber, grape vine, climbing ivy – all the same type.
    f) A person cuts a small tree (sapling) growing along the edge of their basement. Later in the summer, he notices several little saplings all growing out of the old stump and root system that was left.
    g) Multicellular algae are struck by a wave. The algae break up and each new piece grows into a new organism.
    h) A small cell begins to grow on the outside of another cell. Eventually, it breaks away from the larger cell and continues to grow.

Asexual Reproduction (pp. 159-161)

47. The offspring of asexual reproduction result from 1 cell splitting into 2 cells, and they are exact duplicates of the parent, with identical genetic code. The offspring of sexual reproduction are the result of 2 half-cells combining to form a single complete cell with brand new, unique genetic code.
48. 5 types of asexual reproduction:
    binary fission - one-celled organisms split into 2 new organisms; e.g. bacteria
    budding - a small outgrowth of the parent organism breaks off and starts a new organism; e.g. yeast
    fragmentation - when an organism is separated into pieces, each piece grows a new organism; e.g. sea star; potato tubers
    spore formation - cluster of cells form on the parent, and the parent eventually dies while each cluster/spore becomes a new organism; e.g. mould, fungi
    vegetative reproduction - an organism produces runners that grow and sprout new offspring; it is common for many of the growths to stay attached to each other; e.g. squash, strawberries
49. The term "zygote" can only be used for the single cell of an organism that begins by sexual reproduction – sperm joining egg. Daughter cells from mitosis cannot be called zygotes.
50. An advantage of an organism that reproduces asexually is that strong or beneficial traits get passed along to the offspring over and over. Two disadvantages are that weak traits get passed along, and there is no variety in the offspring.

51. An advantage of organisms/species that reproduces sexually is that the offspring all have new and various traits. Some disadvantages are that it is usually slower/longer than asexual reproduction (gestation period); requires 2 separate organisms (opposite genders).
52. Classify each of the following as one of the 5 types of asexual reproduction:
    a) fragmentation - A potato is cut into pieces, and each piece grows a new potato plant.
    b) vegetative reproduction - After a potato seed piece is planted, the sprouts grow and produce new plants.
    c) vegetative reproduction - A dandelion plant sends out an underground root or "runner" and other dandelions "spring up".
    d) binary fission - A paramecium (one-celled organism) splits to give two new organisms.
    e) vegetative reproduction - Squash, pumpkin, cucumber, grape vine, climbing ivy – all the same type.
    f) vegetative reproduction - A person cuts a small tree (sapling) growing along the edge of their basement. Later in the summer, he notices several little saplings all growing out of the old stump and root system that was left.
    g) fragmentation - Multicellular algae are struck by a wave. The algae break up and each new piece grows into a new organism.
    h) budding - A small cell begins to grow on the outside of another cell. Eventually, it breaks away from the larger cell and continues to grow.

Hormones, Growth, and Aging (pp. 164-171)

53. What is the definition of a hormone?
54. Name 2 plant growth hormones, and what each one specifically controls.
55. What is name of the growth hormone in humans?
56. The growth (by reproduction of cells) for some human tissues seems to be pre-programmed. For others, there seem to be stimulants that can cause certain tissues (cells) to reproduce to add cells. For example, what are calluses, and what causes them to form?
57. Refer to the Case Study on pp. 168-169, and answer the questions a - j.
58. If we bruise or cut ourselves, we may damage skin or lose blood. By heart attack, stroke, or ingesting damaging chemicals, we damage heart and/or brain cells. Based on your understanding of these different kinds of cells, why is heart or brain cell damage so much more serious than a bruise or cut?
59. Do your own research to find out what gland contains and secretes the human growth hormone. Where is this gland located?
60. Do your own research to name at least 6 different human hormones, the glands that secrete them, and what these hormones do.
61. Why does the brain stop growing (adding more cells) at about age . . . heart ~age 14 . . . bones ~age 20?
62. What causes aging? (focus on the cells)

Hormones, Growth, and Aging (pp. 164-171)

53. A hormone is a chemical messenger that communicates among cells.
54. Name 2 plant growth hormones:
    1. auxin - controls growth in length (toward Sun)
    2. cytokinin - controls growth in width
55. Growth hormone (GH) is name of the growth hormone in humans.
56. Calluses are outer layers of dead skins cells. When the skin in a certain area is irritated, the skin cells in that area respond to a message from the brain via GH to activate cell division and make more cells.
57. Case Study on pp. 168-169, and answer the questions a - j:
    a. arms and legs grow a lot between 2 month-old fetus and infant
    b. arms, legs, shoulders appear to grow most between infancy and adulthood
    c. The head and torso appear to grow the least, compared to the rest of the body, from infant to adulthood.
    d. The head grows first/fastest because the brain is necessary for all other growth and functions.
    e. Body mass increases about 19 times from age 1 to 19.
       Heart mass increases about 13 times from age 1 to 19.
    f. Brain reaches full size at about age 4.
    g. The heart and brain grow at same rate until age 4; then brain growth stops, while the heart continues growing.
    h. Based on the chart, it would appear the heart and body would continue growing after age 19. However, based on observing what actually happens with people, the heart is fully grown at 18 and body is typically done growing by age 20-22.
    i. The shin bone grows faster, during the period shown in the 3 diagrams.
58. Heart or brain cell damage is much more serious than a bruise or cut because our bodies can replace blood and skin, but not heart or brain cells.
59. The human growth hormone is one of several hormones secreted by the pituitary gland, which is located at the base of the brain and is about the size of a pea.
60. Do your own research to name at least 6 different human hormones, the glands that secrete them, and what these hormones do.

61. Growth of an organ (organ tissue) stops because there appears to be an inherent limit to the number of times that certain cells divide (predetermined in each individual's DNA). When this limit is reached, cells stop dividing so growth ceases. Once the genetic coding in the cell that controls cell division is inactivated, cannot be reactivated with GH.
62. Aging is the result of cells wearing out as they carry out their normal functions over the years. Also, as cells are damaged or die, they do not get replaced because the part of the genetic code that controls cell division cannot be reactivated; they reached their predetermined limit years ago for the number of times they would divide.

CHAPTER 6

DNA, Codons, Genes, Chromosomes, Chromatin (pp. 176-178)

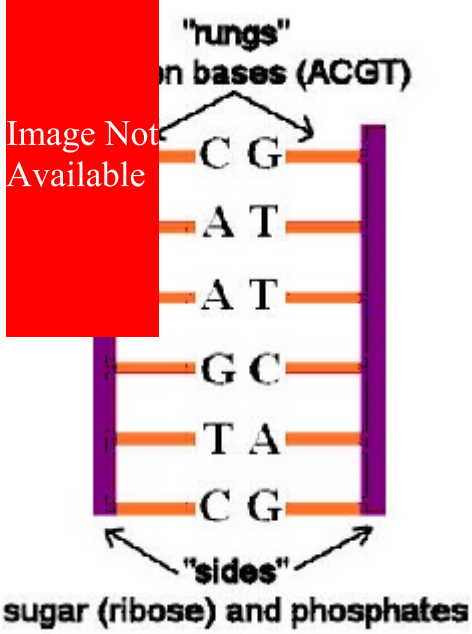
63. Powerpoint: "DNA.ppt"
64. What does DNA stand for? What does DNA do?
65. What molecules make up the sides of the DNA strands?
66. What are the four nitrogen bases that make up genetic code within the "rungs" in DNA?
67. What is the pattern of pairing of these nitrogen bases "up and down" the double helix of the DNA molecules?
68. Why are organisms so different if all living organisms are made up of the same four bases? (top p. 177)
69. What is the one-word term for the process of the DNA making a copy of itself? Explain it. (see fig. 2 p. 177)
70. Draw a chromosome, showing the strands of DNA inside. (Hint: see p. 177 "Did You Know?")
71. Write the definition for each of the following: chromatin, chromosome, gene, codon
72. Compare the relative size and relationship among chromatin, chromosome, gene, codon, and DNA.
73. When DNA fingerprinting is done, would it make any difference what kind of cells were used from a person?

DNA, Codons, Genes, Chromosomes, Chromatin (pp. 176-178)

63. Powerpoint: "DNA.ppt"
64. DNA stands for deoxyribonucleic acid. DNA is the language of the unique genetic code of an organism, and it determines how a cell functions.
65. The sides of the DNA strands are made up of phosphates and ribose (a type of sugar).
66. The four nitrogen bases that make up genetic code within the "rungs" in DNA are adenine, cytosine, guanine, and thymine.
67. The pattern of pairing of these nitrogen bases "up and down" the double helix of the DNA molecules is: A pairs with T, and C with G.
68. Even though DNA is only made up of 4 different nitrogen bases, there are 6 billion of these bases (letters A, C, G, T) that make up about 100,000 genes within our 46 chromosomes – that's a LOT of possible sequence variations!

69. Replication is the one-word term for the process of the DNA making a copy of itself. It occurs as the helix splits down the middle and then rebuilds the opposite side of each of the 2 strands with the corresponding letter (nitrogen base A, C, G, T).

70. Image Not Available



71. chromatin - long, fibrous strands in the nucleus that include the chromosomes and connecting material
chromosome - a section of DNA containing certain genes; shorter ones contain ~100 genes; longer ones contain ~1000 genes.
gene - a portion of DNA inside a chromosome that controls a particular trait
codon - a sequence of 3 nitrogen bases within a gene

72. chromatin (all the chromosomes) = library
chromosome = book
gene = page
codon = word
DNA = language made up of 4 letters

73. When DNA fingerprinting is done, it would not make any difference what kind of cells were used from a person, since the genetic code inside the chromosomes of the nucleus is the same in all of an organism's cells.

Cancer (pp. 180-183)

74. Powerpoint "Cancer.ppt"
75. Write one-sentence definitions for: cancer, carcinogen, mutation
76. List the 3 types of carcinogens.
77. Write a one-sentence explanation of the relationship among cancer, carcinogen, mutation. For example, write

the following sentence, and fill in the blanks: *A _____ causes a _____ in the section of genetic code in the DNA that regulates cell division, which leads to _____.*

78. List 4 ways in which cancer cells differ from normal cells? (See p. 181, including fig. 3)
79. Is all rapid cell growth classified as cancer? Discuss and give examples. (See p. 181 "Making Connections")
80. What is a tumour?
81. Describe the difference between benign and malignant tumours.
82. Carry out your research, and find out about at least 3 different kinds of cancer.

Cancer (pp. 180-183)

74. Powerpoint "Cancer.ppt"
75. Cancer is a set of diseases associated with unregulated, uncontrolled cell division, which produces cells that have no function and do nothing but further divide.

    A carcinogen is any substance or radiation that leads to cancer (by causing a mutation in the genetic sequence that controls cell division).

    A mutation is a change in the genetic sequence or code.
76. 3 types of carcinogens: viruses, radiation, hazardous chemicals
77. *A carcinogen causes a mutation in the section of genetic code in the DNA that regulates cell division, which leads to cancer.*
78. 4 ways in which cancer cells differ from normal cells:
    1. Cancer cells divide at a very rapid rate.
    2. Cancer cells can divide in isolation.
    3. Cancer cells do not change shape and specialize as they mature (no function).
    4. Cancer cells have enlarged nuclei, and reduced cytoplasm.
79. All rapid cell growth is not classified as cancer. Skin and blood cells naturally divide rapidly? Growths like warts, cysts, and some tumours are not cancerous.
80. A tumour is an abnormal mass of cells that have no function – may be solid or filled with fluid (cyst).
81. benign tumour - harmless, either temporarily or long-term, because it does not spread to other tissues/cells.

    malignant tumour - harmful because the cells can break away and move to other areas (metastasize).
82. lung, prostate, breast, ovarian, brain, leukemia, lymphoma, skin

Regeneration and Specialization (pp. 186-187)

83. Define regeneration.
84. Can all humans cells regenerate? Which ones?
85. What is the difference between regeneration and fragmentation?
86. Define specialization, as it relates to cells.
87. Define a "complex organism", in terms of cell specialization.

88. How does the DNA of a human kidney cell compare to that of skin, blood, brain, heart?
89. Search for the term, "totipotent", and write its definition. (e.g. *Visions* text or web search)
90. What is the relationship between cell specialization and regeneration?
91. When talking about specialized cells, the phrase "turned off" is used. Why? In what way? What does it mean?
92. What is a stem cell?
93. Skip ahead to p. 196. How soon do cells of a new organism (starting as a zygote) begin to specialize?

Regeneration and Specialization (pp. 186-187)

83. **regeneration** - the ability to regrow a tissue, organ, or part of the body. Specialized adult cells can de-specialize back to totipotent cells that can then re-specialize as needed.
84. Only a few types of human cells can regenerate, such as skin, blood, bone (liver and kidney have very limited capacity).
85. Regeneration regrows part of an organism, whereas fragmentation refers to the reproduction of a new organism.
86. **specialization** - cells only use a small part of the DNA code to carry out certain functions (e.g. heart, lung, bone, nerve, etc.)
87. A complex organism is one that has a lot of cell specialization to carry out different functions, with advanced organ systems.
88. The DNA in cells of human kidney, skin, blood, brain, heart, etc. is the very same. However, different sections of the same DNA code are functioning for the different specialized cells.
89. **totipotent** - the ability of a single cell to divide and produce all the differentiated cells in an organism
90. The more cell specialization in an organism, the less capacity or likelihood there is for the cells to be totipotent for regeneration.
91. When talking about specialized cells, the term "turned off" refers to the sections of the DNA code in the chromosomes that are not being used to carry out the specific function of that cell. Only certain sections of the DNA code are "turned on", and once the sections are not used or "turned off", they cannot be turned back on.
92. **stem cell** - unspecialized cell, that can divide to become a specialized cell (can also divide to make more stem cells).
93. After a new organism forms as a zygote (from sexual reproduction), the first steps towards specialization begin after the 8-cell stage (i.e. 16-cell stage).

Cloning (pp. 194-197; 190-193)

94. What is cloning? (See p. 194, under "Only One Parent")
95. Does the term cloning just apply to specialized, technical laboratory procedures of reproduction?
96. Is cloning sexual or asexual reproduction?

97. "*All asexual reproduction (binary fission, budding fragmentation, spore formation, reproduction) is cloning*." Is this statement true or false? Discuss in 1-3 sentences.
98. Since mitosis produces 2 identical daughter cells, why is it not classified as cloning?
99. Read and examine pp. 190-193. Talk to some gardeners, people who grow plants, and do some research of your own. Cuttings, slips, grafts – how do they work? What are some specific plants?
100. How is artificial cloning different from normal cloning?
101. Have scientists had similar success with artificial cloning of an organism, using any kind of cell? What appears to be the key for choosing cells?
102. What is an enucleated cell? How is it done?
103. Artificial cloning is designed to produce several identical offspring. Why does it involve "destroying embryos"?
104. What was different about the cloned sheep that was named "Dolly"? Why was she named Dolly?

Cloning (pp. 194-197; 190-193)

94. **cloning** - the process of forming identical offspring from a single cell or tissue.
95. Cloning is a natural process, repeated daily in nature. The vast majority of organisms reproduce by cloning – all asexual reproduction is cloning of organisms.
96. Cloning is asexual reproduction, since it starts with a somatic cell to duplicate by mitosis.
97. The statement, "All asexual reproduction is cloning", is indeed true. A new organism begins with the same genetic code, and gets its start by mitosis.
98. All mitosis is not classified as cloning because it only copies a cell, whereas cloning copies an organism.
99. Common house plants that are cloned are spider plants, geraniums
100. Artificial cloning is done in a lab with organisms that would naturally only reproduce sexually.
101. Scientists have only had very limited success with artificial cloning. The best results appear to come from embryonic stem cells up to the 8-cell stage (up to 3 mitosis divisions from the zygote).
102. An enucleated cell has had it's nucleus artificially removed. It is done by scientists using a tiny glass tube/needle.
103. Cloning from embryonic cells destroys the embryo because the cells have to be separated.
104. The reason the cloning of the sheep that was named Dolly was unique was that the initial cell that was cloned was not embryonic – it came from an adult sheep's udder. The scientists named the cloned sheep Dolly after Dolly Parton, in recognition of her large mammary duets.

CHAPTER 7

Sexual Reproduction, Genomes, and Meiosis (pp. 200-207)

105. How are the offspring of sexual reproduction different from the offspring of asexual reproduction? (p. 202)
106. In terms of chromosomes, how do female mammals differ from male mammals? (p. 204)
107. Carry out your own research on the meaning of the word, "genome". For example, what is meant by the "human genome"?
108. What is meant by the terms *diploid* and *haploid*?
109. What is the number of chromosomes in the genome set of each of the following species? (i.e. n = ?)
    a) human b) dog c) mouse d) ape e) corn f) blueberry (will need your own research)
110. A muscle cell from a mouse has 22 chromosomes. How many chromosomes would you expect in:
    a) An egg cell?
    b) A zygote?
    c) A brain cell?
    d) A blood cell?
    e) A sperm cell?
111. What is a zygote?
112. If a zygote has 45 chromosomes, how many chromosomes would you expect to find in nerve cells as they develop? Why?
113. Define the term, *meiosis*.
114. Draw a 3-stage summary of meiosis, showing the starting (reproductive) cell, mid-stage (end of meiosis I), and final stage (end of meiosis II).
115. What are two differences between mitosis and meiosis?
116. What are somatic cells? What are reproductive cells? What are sex cells?
117. a) In what way are somatic and reproductive cells the same? (refer to chromosomes)
    b) In what way are somatic and reproductive cells different? (refer to division)
118. Use the terms, diploid and haploid, to describe a) somatic, b) reproductive, and c) sex cells.
119. In a human, describe the number of chromosomes in any a) somatic, b) reproductive, and c) sex cells.
120. Of all the cells in an organism, which kind of cells are there mostly, by far? (somatic, reproductive, sex)
121. A dog has 78 chromosomes in each somatic cell. Give the number of each of the following:
    a) n (haploid) =
    b) 2n (diploid) =
    c) number of chromosomes in a somatic cell
    d) number of chromosomes in a reproductive cell
    e) number of chromosomes in a sex cell
122. What are homologous chromosomes?
123. Do homologous chromosomes have the same number of genes?
124. How do homologous chromosomes (from sex cells) produce offspring (zygotes) with a brand new code for the new organism?
125. What is genetic screening? In what type of chart are chromosomes arranged to help determine if a fetus has a genetic disorder?

Sexual Reproduction, Genomes, and Meiosis (pp. 200-207)

105. The offspring of sexual reproduction have new, unique genetic code, whereas the offspring of asexual reproduction are exact duplicates of the parent.
106. The chromosomes of female mammals have 2 X-chromosomes, while male cells have an X and a Y chromosome pair. (X codes for female, Y codes for male; X-X is female gender; X-Y is male).
107. **genome** - number of pairs of chromosomes in the cells of a species
108. **diploid** - a cell with paired chromosomes (somatic and reproductive)
    haploid - a cell with single chromosome; half the total number (sex cells)

109. a) human n = 23 b) dog n = 39 c) mouse n = 20 d) ape n = 24
e) corn n = 10 f) blueberry n = ?
110. If a mouse's muscle (somatic) cell has 22 chromosomes:
    a. egg = 11
    b. zygote = 22
    c. brain = 22
    d. blood = 22
    e. sperm = 11
111. **zygote** - fertilized egg; a single diploid cell formed from 2 haploid cells from sexual reproduction of sperm combining with egg.
112. If a zygote has 45 chromosomes (unusual), a nerve cell that developed/specialized would also have 45 chromosomes, because all cells from the zygote would have identical nuclei – mitosis.
113. **Meiosis** is the method of cell division in reproductive cells to produce 4 sex cells. (A reproductive cell can only divide once - the sex cells do not divide further.)
114. Copy p. 207 Figure 3 "Meiosis"

115. **2 Differences Between Mitosis and Meiosis**
    - Mitosis can keep occurring as cells keep splitting, whereas meiosis can only happen once to a cell.
    - Mitosis produces 2 daughter cells that are identical with paired chromosomes, whereas meiosis produces 4 gametes (sex cells) that have single chromosomes with varying DNA.
116. **Somatic cells** are diploid cells that divide by mitosis (normal body cells).
    Reproductive cells are diploid cells that divide by meiosis to make sex cells.
    Sex cells are haploid cells that do not divide, but join together in sexual reproduction.
117. Similarities in somatic and reproductive cells:
    a. Somatic and reproductive cells both have paired chromosomes.
    Differences in somatic and reproductive cells:
    b. Somatic cells can divide many times by mitosis; reproductive cells can only divide once by meiosis.
118. a. somatic - diploid
    b. reproductive - diploid
    c. sex - haploid

119. Referring to humans cells:
    a. somatic - 46 chromosomes (2n)
    b. reproductive - 46 chromosomes (2n)
    c. sex - 23 chromosomes (n)
120. In any organism, the vast majority of cells by far are somatic cells.
121. For the dog species (with 78 chromosomes):
    a. n = 39
    b. 2n = 78
    c. somatic cells = 78 chromosomes
    d. reproductive cells = 78 chromosomes
    e. sex cells = 39 chromosomes
122. **Homologous chromosomes** are similar paired chromosomes that carry genes that code for the same trait, in the same order and position on the chromosome; one from the mother and one from the father.
123. Homologous chromosomes have the same number of genes, since they are the same length with the same order or sequence of code.
124. Homologous chromosomes pair up in a zygote, but the genetic code is brand new because the genetic traits will be a combination from both chromosomes.